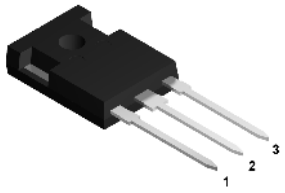
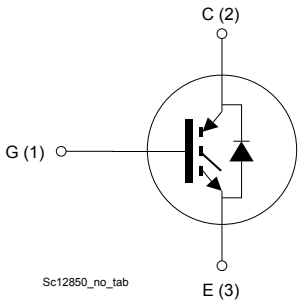
STGWA50M65DF2

Datasheet

Trench gate field-stop 650 V, 50 A low-loss M series IGBT in a TO-247 long leads package



TO-247 long leads



Features

- Maximum junction temperature: T_J = 175 °C
- 6 µs of minimum short-circuit withstand time
- $V_{CE(sat)}$ = 1.65 V (typ.) @ I_C = 50 A
- Tight parameter distribution
- Safer paralleling
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Soft- and fast-recovery antiparallel diode

Applications

- Motor control
- UPS
- PFC
- General purpose inverter

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where the low-loss and the short-circuit functionality is essential. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and the tight parameter distribution result in safer paralleling operation.

Product status link
STGWA50M65DF2

Product summary	
Order code	STGWA50M65DF2
Marking	G50M65DF2
Package	TO-247 long leads
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650	V
I_C(1)	Continuous collector current at T_C = 25 °C	80	A
	Continuous collector current at T_C = 100 °C	50	
I_{CP}(2)	Pulsed collector current	150	A
V_{GE}	Gate-emitter voltage	±20	V
I_F(1)	Continuous forward current at T_C = 25 °C	80	A
	Continuous forward current at T_C = 100 °C	50	
I_{FP}(2)	Pulsed forward current	150	A
P_{TOT}	Total power dissipation at T_C = 25 °C	375	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. *Limited by package.*
2. *Pulse width is limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case, IGBT	0.4	°C/W
	Thermal resistance, junction-to-case, diode	0.96	
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 250 µA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 50 A		1.65	2.1	V
		V_{GE} = 15 V, I_C = 50 A, T_J = 125 °C		1.95		
		V_{GE} = 15 V, I_C = 50 A, T_J = 175 °C		2.1		
V_F	Forward on-voltage	I_F = 50 A		1.85	2.65	V
		I_F = 50 A, T_J = 125 °C		1.65		
		I_F = 50 A, T_J = 175 °C		1.55		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 650 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	4200	-	pF
C_{oes}	Output capacitance		-	252	-	nF
C_{res}	Reverse transfer capacitance		-	88	-	nF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 50 A, V_{GE} = 0 to 15 V (see Figure 29. Gate charge test circuit)	-	150	-	nC
Q_{ge}	Gate-emitter charge		-	32	-	nC
Q_{gc}	Gate-collector charge		-	62	-	nC

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 50 A, V_{GE} = 15 V, R_G = 6.8 Ω (see Figure 28. Test circuit for inductive load switching)		42	-	ns
t_r	Current rise time			21	-	ns
$(di/dt)_{on}$	Turn-on current slope			1942	-	A/µs
$t_{d(off)}$	Turn-off delay time			130	-	ns
t_f	Current fall time			104	-	ns
E_{on} (1)	Turn-on switching energy			0.88	-	mJ
E_{off} (2)	Turn-off switching energy			1.57	-	mJ
E_{ts}	Total switching energy			2.45	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 50 A, V_{GE} = 15 V, R_G = 6.8 Ω, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)		42	-	ns
t_r	Current rise time			24	-	ns
$(di/dt)_{on}$	Turn-on current slope			1700	-	A/µs
$t_{d(off)}$	Turn-off delay time			131	-	ns
t_f	Current fall time			184	-	ns
E_{on} (1)	Turn-on switching energy			1.97	-	mJ
E_{off} (2)	Turn-off switching energy			2.22	-	mJ
E_{ts}	Total switching energy			4.19	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 400 V, V_{GE} = 13 V, T_{Jstart} ≤ 150 °C	10		-	µs
		V_{CC} ≤ 400 V, V_{GE} = 15 V, T_{Jstart} ≤ 150 °C	6		-	

1. *Including the reverse recovery of the diode.*
2. *Including the tail of the collector current.*

Table 6. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 50 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs (see Figure 28. Test circuit for inductive load switching)	-	162	-	ns
Q_{rr}	Reverse recovery charge		-	1.37	-	µC
I_{rrm}	Reverse recovery current		-	19	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	420	-	A/µs
E_{rr}	Reverse recovery energy		-	192	-	µJ
t_{rr}	Reverse recovery time	I_F = 50 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)	-	262	-	ns
Q_{rr}	Reverse recovery charge		-	5.1	-	µC
I_{rrm}	Reverse recovery current		-	34	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	160	-	A/µs
E_{rr}	Reverse recovery energy		-	676	-	µJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature

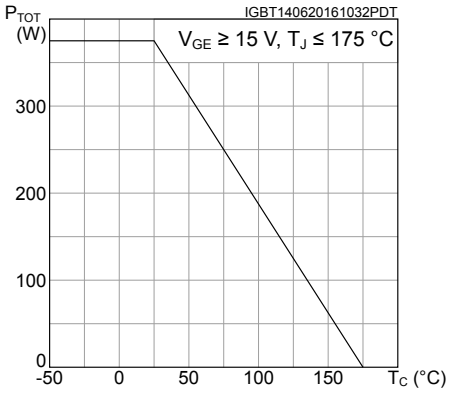


Figure 2. Collector current vs. case temperature

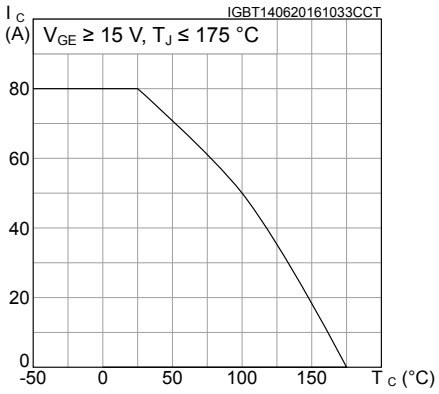


Figure 3. Output characteristics (T_J = 25 °C)

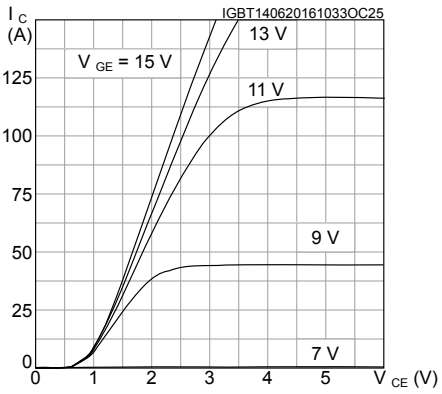


Figure 4. Output characteristics (T_J = 175 °C)

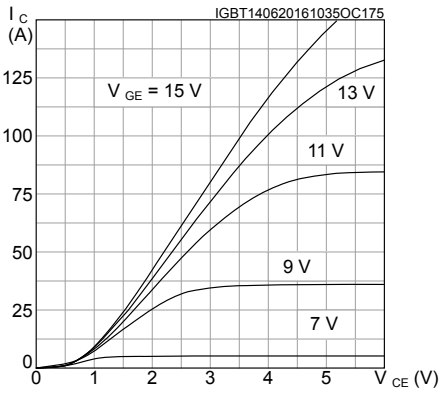


Figure 5. V_{CE}(sat) vs. junction temperature

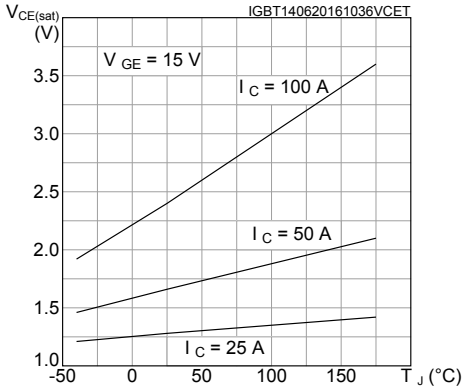


Figure 6. V_{CE}(sat) vs. collector current

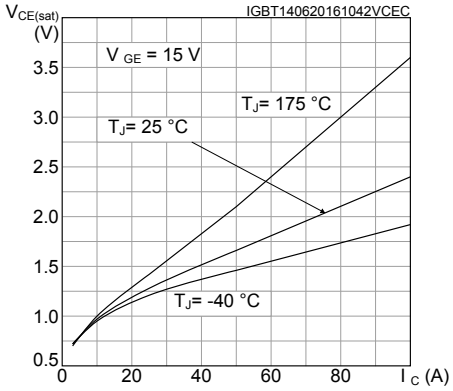


Figure 7. Collector current vs. switching frequency

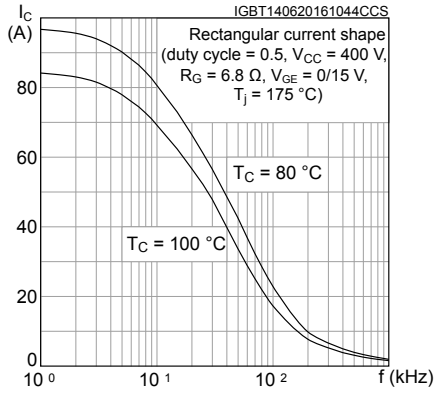


Figure 8. Forward bias safe operating area

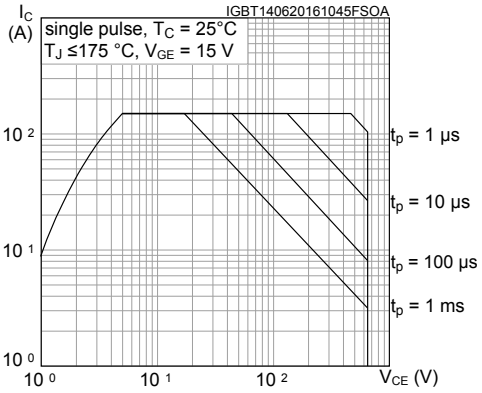


Figure 9. Transfer characteristics

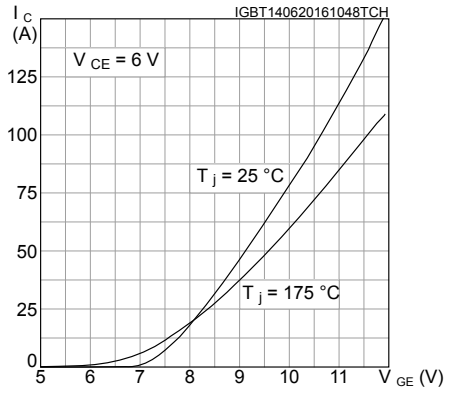


Figure 10. Diode V_F vs. forward current

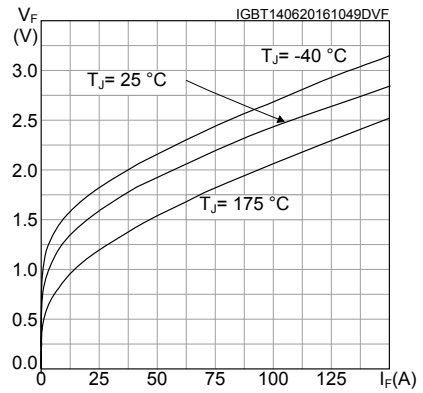


Figure 11. Normalized $V_{GE(th)}$ vs. junction temperature

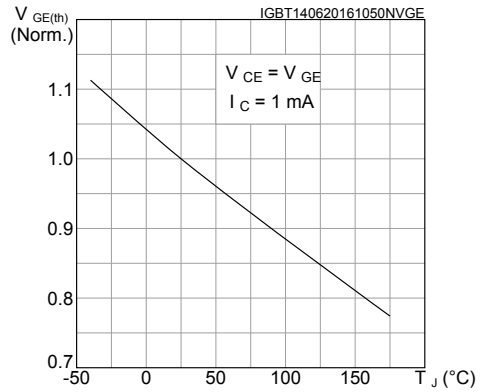


Figure 12. Normalized $V_{(BR)CES}$ vs. junction temperature

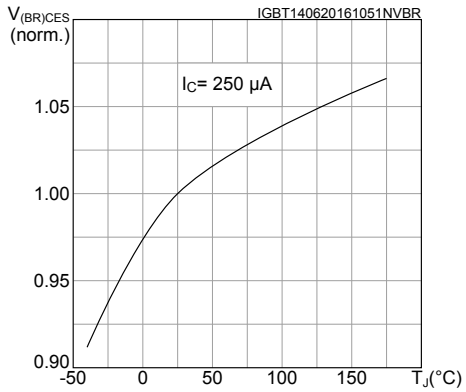


Figure 13. Capacitance variations

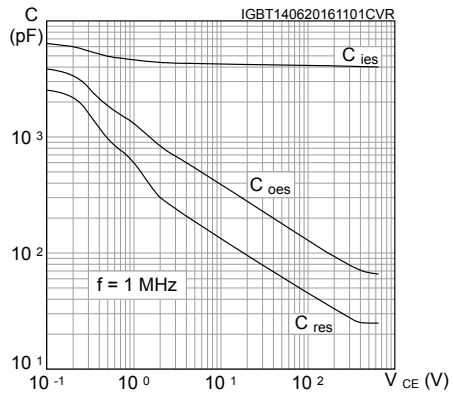


Figure 14. Gate charge vs. gate-emitter voltage

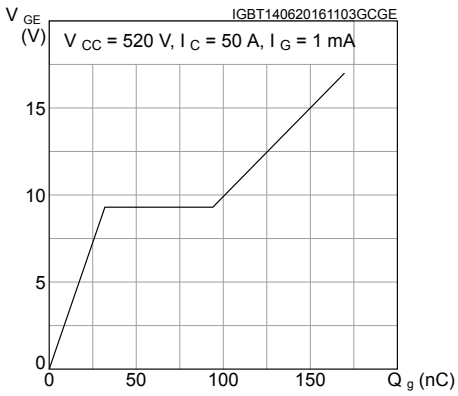


Figure 15. Switching energy vs. collector current

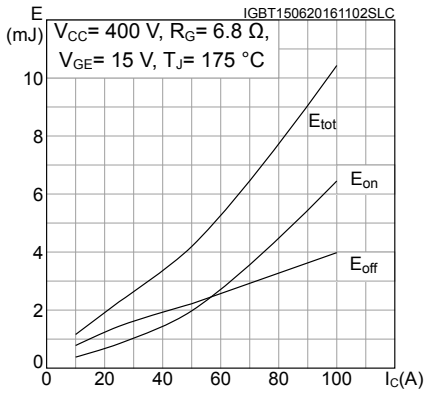


Figure 16. Switching energy vs. gate resistance

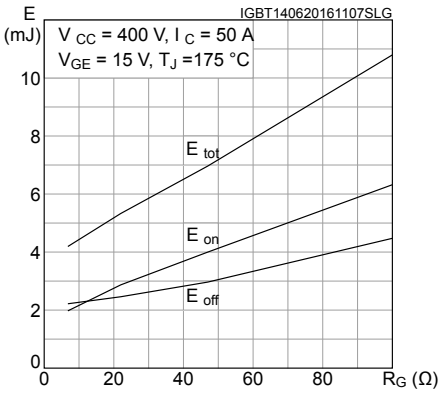


Figure 17. Switching energy vs. temperature

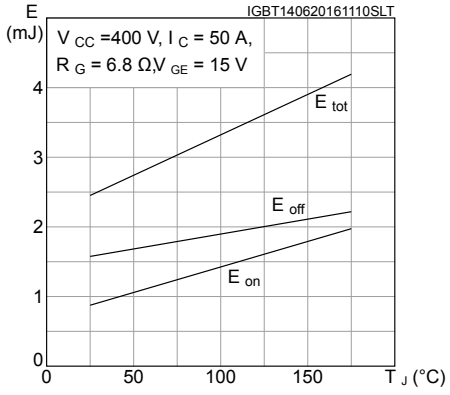


Figure 18. Switching energy vs. collector emitter voltage

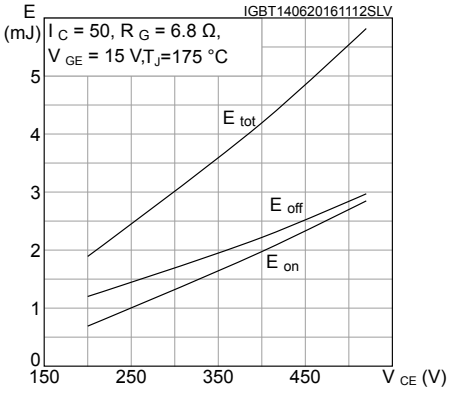


Figure 19. Short-circuit time and current vs. V_{GE}

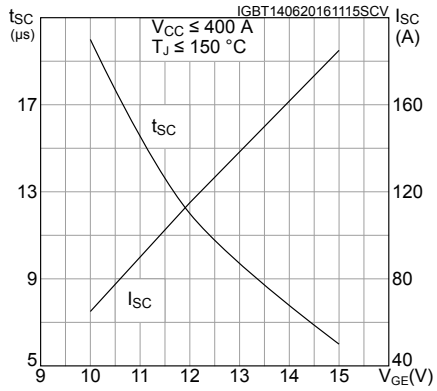


Figure 20. Switching times vs. collector current

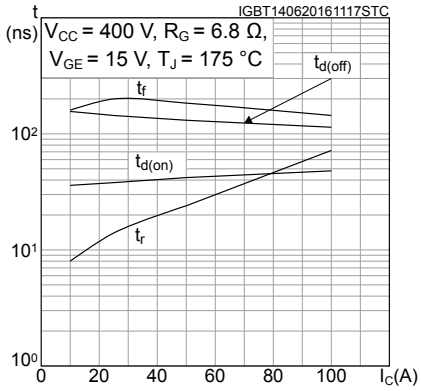


Figure 21. Switching times vs. gate resistance

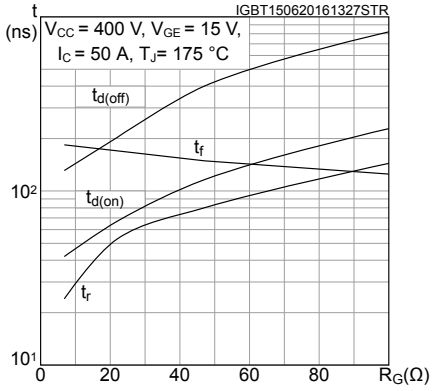


Figure 22. Reverse recovery current vs. diode current slope

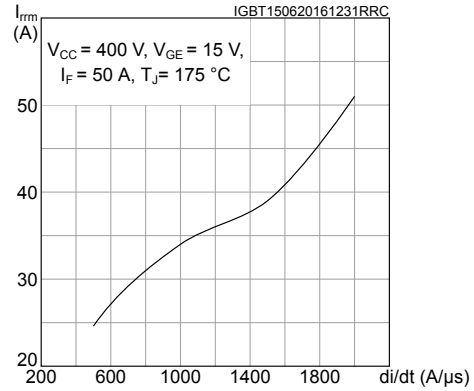


Figure 23. Reverse recovery time vs. diode current slope

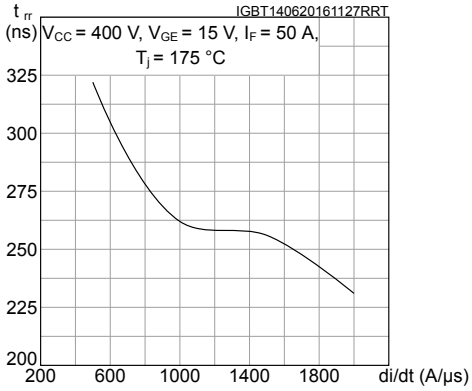


Figure 24. Reverse recovery charge vs. diode current slope

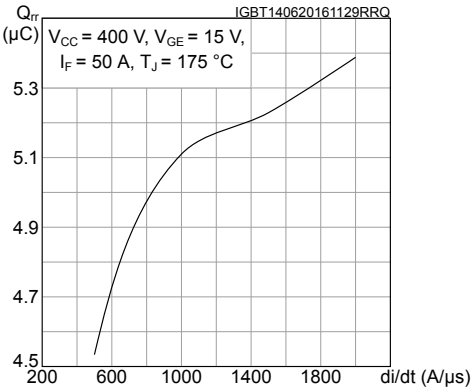


Figure 25. Reverse recovery energy vs. diode current slope

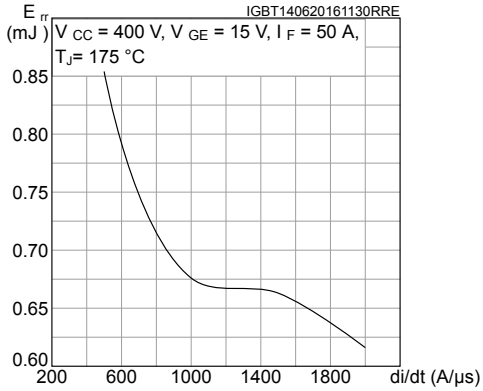


Figure 26. Thermal impedance for IGBT

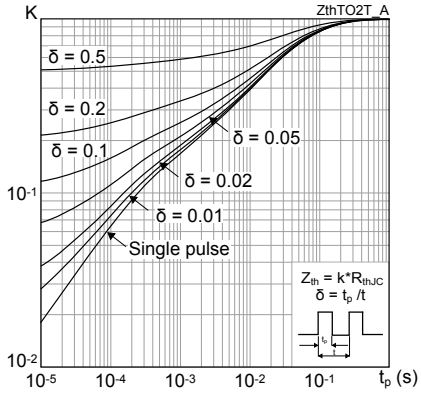
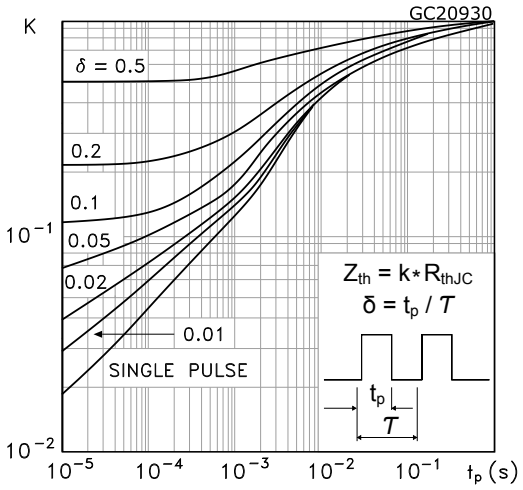


Figure 27. Thermal impedance for diode



3 Test circuits

Figure 28. Test circuit for inductive load switching

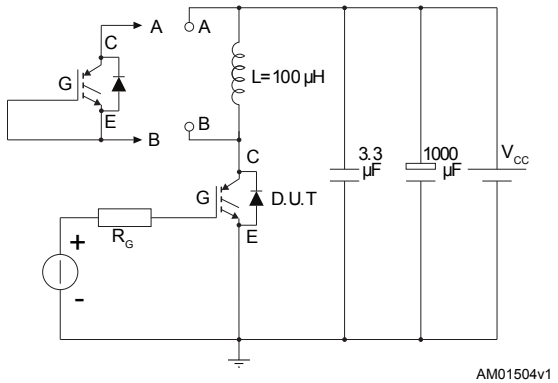


Figure 29. Gate charge test circuit

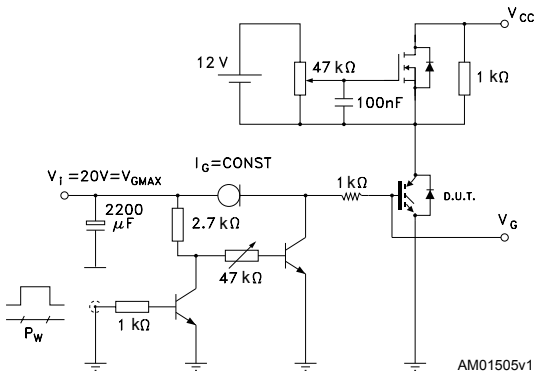


Figure 30. Switching waveform

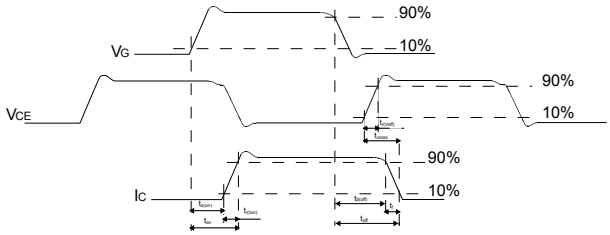
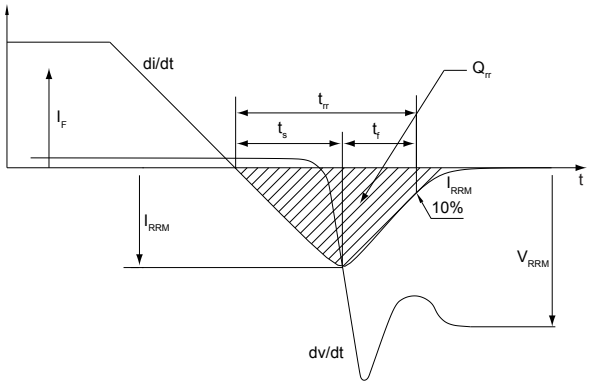


Figure 31. Diode reverse recovery waveform

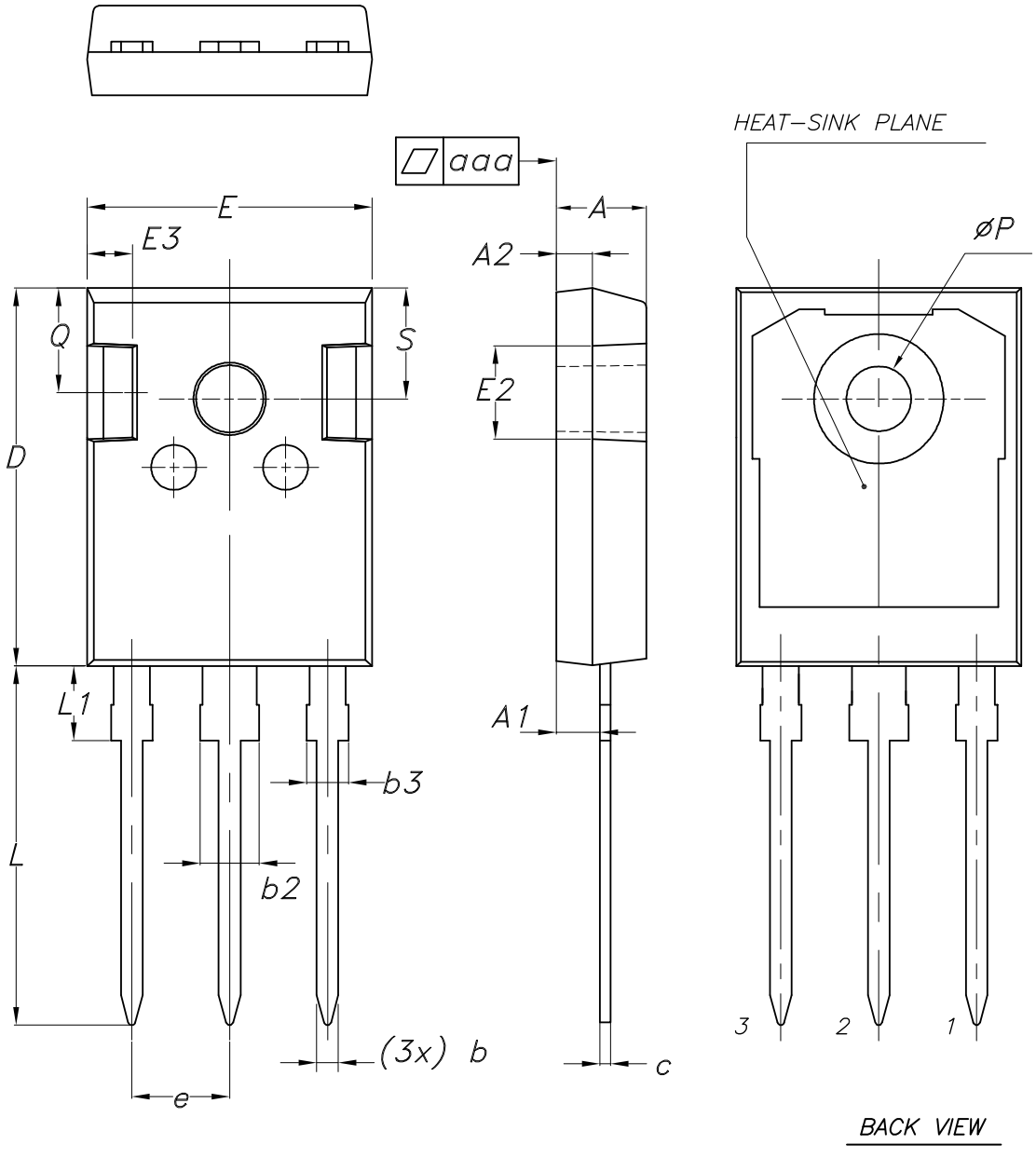


4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

4.1 TO-247 long leads package information

Figure 32. **TO-247 long leads package outline**



8463846_3

Table 7. **TO-247 long leads package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

Revision history

Table 8. **Document revision history**

Date	Revision	Changes
27-Nov-2015	1	First release.
14-Jun-2016	2	Modified: *features* and *applications* in cover page Modified: *Table 2: "Absolute maximum ratings"*, *Table 4: "Static characteristics"*, *Table 5: "Dynamic characteristics"*, *Table 6: "IGBT switching characteristics (inductive load)"*, *Table 7: "Diode switching characteristics (inductive load)"* Added: *Section 2.1: "Electrical characteristics (curves)"* Minor text changes
02-May-2017	3	Modified: title, *features* and *applications* on cover page. Modified *Table 4: "Static characteristics"*, *Table 7: "Diode switching characteristics (inductive load)"* and *Figure 13: "Normalized $V_{(BR)CES}$ vs. junction temperature* ". Updated *Section 4: "Package mechanical data"*. Minor text changes.
31-Mar-2023	4	Updated Table 3. Static characteristics. Updated Section 4.1 TO-247 long leads package information Minor text changes.

Contents